METHOD AND CLEANING FLUID FOR THE WET CLEANING OF OBJECTS

The invention relates to a method and cleaning fluid for the wet cleaning of objects.

During the wet cleaning, soiled objects are normally brought into contact with a highly concentrated, organic solvent, which is adjusted based on the dirt to be removed. A characteristic of this cleaning process is that a relatively large amount of solvent is used and on account of its impurities, must be restored. In addition, particularly when working at greater than room temperatures, fire is a danger, since the solvent fumes usually are easily flammable. With a succession of solvents, it cannot be ruled out that the residue of the solvents remains on the surface of the cleaned object, so that the cleaning must be followed by one or more rinsing processes in order to completely remove the solvent residue.

The object of the present invention is to provide a method and cleaning fluid that do not have the described problems.

The portions of the inventive object relating to the method are solved with the features of the independent claim.

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Surprisingly, it turned out that upon use of a cleaning fluid made up of water and at least one solvent that forms a miscibility gap with water, and when working with a solvent concentration at which the cleaning fluid is in a state of the miscibility gap, the same or even a better cleaning efficiency can be achieved as when a solvent is used exclusively for cleaning, i.e., when the concentration of the solvent is 100%. With the inventive method, the concentration of the solvent can be substantially reduced and lies in the range of 10 % to 20 %, so that the use of the solvent is substantially reduced. Also, with increased temperatures, the vapors produced from the cleaning fluid have such a high water content that no danger of flammability exists. An additional advantage of the inventive method is that the dirt to be removed is deposited on the surface of the aqueous phase of the cleaning fluid, where it can be taken off, so that the cleaning fluid, or more specifically, the solvent, only must be minimally restored. Since the cleaning fluid predominantly contains water, the cleaning fluid not only efficiently removes organic dirt, but also inorganic dirt.

Typical types of dirt on which the inventive method is useable are oil, fat, fluids with resin, pigments, dust, non-hardened epoxy materials, for example adhesives, residue from lapping or polishing paste, residue from machining fluids such as stamping oil, boring and cutting

emulsions, and so on. The inventive method is particularly suitable for cleaning printed circuit boards, templates, and metal parts of various geometries and of various metals. Typical organic solvents are propylene-glycol-ether, esters, ketones with limited water solubility, and so on.

The utilized organic solvent is soluble in water within certain mixture ratio ranges, that is, it forms a clear solution. In a mostly temperature-dependent concentration range, a miscibility gap is present, which generally makes the cleaning fluid cloudy, or forms an emulsion of the type solvent in water. The mixing ratio of the cleaning fluid is preferably adjusted such that at the cleaning fluid temperature, one operates specifically in the range of the miscibility gap. Thus, the danger does not exist that the cleaning fluid passes into the actual solution state.

Upon a mixing of dipropylene-glycol-n-propyl-ether, for example, the miscibility gap begins as soon as more than 5% of the solvent is added to the water at a temperature of approximately 20° C. For a good cleaning result, it is advantageous to work with at least 10% dipropylene-glycol-n-propyl-ether in water.

Preferably, a certain, minimum concentration for organic solvents is employed, which is at 5 and preferably 10% by weight.

Advantageously, during the wet cleaning, the fluid is put into intensive movement, for example by means of ultrasound. Thus, on the one hand, both phases of the cleaning fluid are thoroughly mixed and on the other hand, a massive, mechanical interaction takes place between the cleaning fluid and the object to be cleaned. In this manner, surprisingly, proportionally low excitation output of the ultrasound vibration is sufficient, as are needed with aqueous cleaning fluids, in order also to efficiently remove the types of dirt that commonly are removed with organic solvents and high ultrasound vibrations.

The cleaning temperature preferably lies in a range of between 20 and 50° C. Thus, also temperature-sensitive objects can also be cleaned trouble-free. Not much heat energy is needed. The prevailing vapor pressure is small, whereby the management of the process is simple and the environment is minimally burdened.

Claim 5 is directed to the basic composition of the inventive cleaning fluid. This cleaning fluid differs from common aqueous cleaning fluids in that, as previously explained, the inventive cleaning fluid also

removes organic contaminants. The inventive cleaning fluid differs from common, organic solvent-based cleaning fluid in that it also cleans types of dirt that are removable with water.

Advantageously, the concentration of the organic solvent averages at least 5 %, preferably at least 10 %, by weight. Already with this concentration, a cleaning effect is generally achieved, which is similarly good or even better than the cleaning effect achieved with the plain solvent, however, with the advantage that also water-soluble dirt is dislodged. A further advantage is that upon working with a cloudy solution with the above-described properties, the dislodged dirt is displaced onto the surface of the aqueous phase of the fluid and thus can be easily removed, as previously mentioned.

With one advantageous composition, the organic solvent ispropylene-glycol-ether that preferably has a concentration between 10 and 30% by weight, most preferably between 10 and 20% by weight. Such a cleaning fluid is especially suited advantageously for cleaning various contaminants such as oils, fats, resins, adhesives, and so forth.

With another advantageous composition, the solvent is or contains ether-acetate, for example glycol-ether-acetate, in a concentration

between 5 and 30% by weight, by way of example, preferably between 5 and 15% by weight. Such a cleaning fluid is especially suited for removing unhardened epoxy materials and adhesives. For the propylene-glycol-ether, dipropylene-glycol-n-propyl-ether or dipropylene-glycol-n-butyl-ether can be used, by way of example.

The inventive cleaning fluid can be a simple two-phase system made from water and an organic solvent. Suitable solvents are, for example, glycol-ether, ether-acetate, butyl-acetate, esters, such as malonic acid-ester, lactic acid-ester, ketones, such as acetone, isobutyl-ketones, and so forth.

A multitude of organic solvents are available.

The inventive cleaning fluid can contain a good, water-soluble organic solvent, in which a poorly water-soluble solvent is dissolved, which in this manner is introduced into the water.

For this purpose, for example, a mixture of 80% by weight of a good water-soluble solvent and 20% by weight of a poorly water-soluble or a water-insoluble solvent is prepared and then added to water in a quantity of 10 to 20% by weight.

A glycol-ether, for example propylene-glycol-mono-methyl-ether, dipropylene-glycol-mono-methyl-ether, or tripropylene-glycol-mono-methyl-ether serves as a good water-soluble solvent. As a poorly water-soluble solvent, propylene-glycol-ether is used, by way of example, such as propylene-glycol-mono-butyl-ether, dipropylene-glycol-mono-butyl-ether, tripropylene-glycol-mono-butyl-ether, or propylene-glycol-mono-methyl-ether-acetate, propylene-glycol-diacetate, dipropylene-glycol-dimethyl-ether. Also, terpene and higher alcohols can be used.

In conclusion, the present invention makes possible an outstandingly effective cleaning of complexly contaminated objects with minimal addition of solvents, minimal use of solvents, and minimal environmental burden. Surprisingly, with smaller solvent concentrations, outstandingly good cleaning effects are achieved, for example, adhesives, in particular epoxy adhesive, can be removed with an aqueous cleaning fluid that comprises up to 90% water.

The cleaning fluid used for the inventive method need not necessarily be a cloudy emulsion. The emulsion can also be transparent, whereby the difference between the two emulsions lies in their respective

particle size. In milky-cloudy emulsions, the particles or drops of the organic solvent dispersed in the water generally have a diameter of approximately 0.1 µm, while in transparent emulsions, the particle diameter lies well under 0.1 µm. However, larger particle diameters, that is, cloudy emulsions, are advantageous

It is to be understood that the inventive cleaning fluid can be provided with further properties, for example emulsifiers, corrosion inhibitors, and so forth. In the inventive cleaning fluid, the water content generally is substantially higher than the content of the organic solvent, so that the inner emulsifying phase is formed by the solvent and the outer, cohesive phase is formed by the water. Thus, one speaks of an organic-in-water or solvent-in-water emulsion. For determining whether it is a matter of such an emulsion, reference is made to Römpps Chemical Lexicon ("Chemielexikon)", 8th edition, Franckh'sche Publishing, Stuttgart, 1981, page 1128.

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